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June 1981

ANALYSIS OF M880 TIRE FAILURE ACCIDENTS

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INTRODUCTION

In August 1978 Goodyear started a recall of 9.50 R16.5 steel belted radial tires that were manufactured at its Fayetteville, North Carolina, plant from 1 September 1975 through 28 August 1976. This recall was in response to reports of failures and accidents involving these tires mounted on M880 1 1/4-ton trucks. The problem was in the method by which the rubber was processed during tire manufacture. This problem made the tires subject to separation between the belt plies which causes belt deterioration or separation at the belt edges. In turn, this leads to vibration in the tire and tire failures with sudden air loss.

The recall program was closed out in January 1980 with 55,000 tires having been replaced (Tank-Automotive Command M880 Newsletter Number 12, 13 January 1980). However, since that time National Guard Bureau (NGB) personnel have reported a large number of failures of the replacement Goodyear tire; i.e., preliminary results (26 states reporting) of a NGB survey indicated that 1,211 of the replacement tires had failed since 1 February 1980. NGB was told by TACOM that no recall of the replacement tires was planned; however, Goodyear was producing a second replacement tire (The Wrangler) to be issued as the first replacement tires wear out or blow out. The problem is if the replacement tires are defective as suggested by the NGB survey, then they should also be recalled, not replaced as they fail.

Currently, TACOM reports that the original Goodyear replacement tires are experiencing a 1-1.5% failure rate which is better than civilian experience and that the largest problems are speed and under-inflation; i.e., the operator's manual and Chrysler recommend 35 psi on front tires and 55 psi on rear tires while Goodyear recommends 45 psi on the front tires and 55 psi on rear tires. Goodyear is currently analyzing some of the tires that failed on NGB M880s and will report the results to TACOM in the near future.

To assist TACOM and Goodyear in assessing the performance of the replacement tire, it was decided to analyze M880 accidents before, during, and after the recall. The analysis objectives were to:

1. Identify the M880 accidents caused by tire failure.

2. Determine the cost of M880 tire failure accidents in terms of injuries and property damage.

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3. Determine whether the rate of M880 tire failure accidents decreased after the recall.

4. Determine whether there are any important differences in the rate of M880 tire failure accidents between major US Army Commands (MACOMs).

5. Identify causes of M880 tire failure accidents.

METHOD

Computer records of DA Form 285 M880 accident reports were selected for the following time periods:

1. 1 September 1977 through 31 August 1978 (one year period before the tire recall).

2. 1 January 1979 through 31 December 1979 (a one year period during the tire recall).

3. 1 January 1980 through 31 December 1980 (a one year period after the tire recall).

For each of these periods, two computer matrices were developed which identified the number of accidents, number of injuries, and cost of M880 accidents by MACOM: one matrix for accidents caused by tire failure and one for all M880 accidents regardless of cause. Next, MACOM and Army-wide accident rates were computed for M880 tire failure accidents and for all M880 accidents. (NOTE: The Army Maintenance Management System (TAMMS) reports tactical vehicle mileage and inventory from 1 November - 31 October of each year. This exposure information was used in rate computation even though the accident periods and exposure periods were offset by two or three months.) Last, each of the M880 tire failure accident reports was subjected to hands-on review to verify tire failure and identify cause factors.

RESULTS

The number of accidents, exposure mileage, accident rates, injuries, and cost is shown in Tables 1-4 for all M880 accidents and Tables 5-8 for M880 accidents caused by tire failures. Table 9 shows the results of the hands-on analysis of M880 accidents caused by tire failure. Information from these tables reveals that:

1. During the three year study period there were 2,099 M880 accidents of which 80 (4%) were caused by tire failure.

2. The 2,099 accidents resulted in 22 fatal and 359 non-fatal injuries and cost $6,100,575 for an average of $2,906 per accident. The 80 tire failure accidents accounted for 3 (14%) of the fatal injuries, 44 (12%) of the non-fatal injuries, and $534,056 (9%) of the cost. The average cost of the tire failure accidents was $6,676.

3. Over the three year period the rate of M880 accidents and M880 accidents caused by tire failure decreased as measured by miles driven and vehicle inventory, i.e.:

a. The M880 accident rate per million miles was 7.714 before the Goodyear tire recall, 5.812 during recall, and 4.209 after recall.

b. The M880 accident rate per thousand vehicles was 38.60 before recall, 32.62 during recall, and 24.50 after recall.

c. The M880 tire failure accident rate per million miles was .345 before recall, .205 during recall, and .172 after recall.

d. The M880 tire failure accident rate per thousand vehicles was 1.669 before recall, 1.063 during recall, and .931 after recall.

4. The rate of M880 accidents per million miles showed a year-to-year decrease for all MACOMs except TRADOC and HQDA (Note: rates based on inventory were not computed by MACOM because vehicle inventory by MACOM was not available at the time of this study). For both TRADOC and HQDA the rate decreased during recall and then increased after recall to levels that exceeded the rate before recall.

5. The rate of M880 tire failure accidents per million miles showed a year-to-year decrease for all MACOMs except NGB. The rate for NGB decreased slightly during recall and then increased after recall to a level that exceeded the rate before recall.

6. The hands-on review of the 80 M880 tire failure accident reports revealed that:

a. All 80 accidents were caused by tire failure.

b. In 53 of the cases speed of the vehicle at the time of the accident was reported. The average speed was 46 mph.

c. The causes of the tire failures were improper design or manufacture (31/39%), road hazards (2/3%), and not reported (47/59%).

d. The manufacturers of the failed tires were Goodyear (13/16%) and not reported (67/84%).

DISCUSSION AND CONCLUSIONS

Tire failure accidents were much more severe than the average M880 accident in terms of injury and cost. This is probably due to the high average speed (46 mph) at the time of the accident and subsequent steering difficulties.

The rate of M880 accidents showed a decreasing trend over the study period. The reason for this decrease is not known and cannot be accounted for solely by the decrease in tire failure accidents. Nevertheless, TRADOC and HQDA have shown a reversal in their M880 accident rates and this problem should receive attention.

The rate of M880 tire failure accidents decreased during and after the recall. It appears that a combination of factors has contributed to this decrease: correction of a faulty manufacturing process by Goodyear, increased emphasis on correct tire maintenance and use, and a greater awareness of the hazards of tire failure by M880 operators.

Since NGB was the only MACOM which had a rate of tire failure accidents that was higher after the recall than before, their concern is well justified. The reason for this increased rate is not known but may be attributed to an increase in the quality of NGB accident investigations and reports; i.e., NGB recently completed its staffing of state safety specialists and one of their functions is to improve quality control of NGB accident investigations and reports. However, the information from M880 accident reports indicates that accidents resulting from improperly designed or manufactured tires is definitely decreasing.

TABLE 1

All M880 Accidents: 1 Sep 77 - 31 Aug 78

MACOM	Accidents	Miles Driven	Rate Per Million Miles	Injuries		Total Cost($)
				Fatal	Non-Fatal	
FORSCOM	173	25,686,000	6.735		25	448,952
TRADOC	10	1,599,000	6.254		1	6,197
HQDA	4	780,000	5.128		1	4,430
NGB	106	25,578,000	4.193		14	121,421
DARCOM	3	442,000	6.787			3,708
ASA	5	342,000	14.620			10,454
USACC	20	1,588,000	12.590		7	45,179
HSC	1	22,000	45.450			310
USAREUR	381	34,248,000	11.110	2	45	816,976
8th Army	37	5,634,000	6.567	4	17	147,904
COE		7,000				
Total	740	95,926,000	7.714	6	110	1,605,531

TABLE 2

All M880 Accidents: 1 Jan 79 - 31 Dec 79

MACOM	Accidents	Miles Driven	Rate Per Million Miles	Injuries		Total Cost($)
				Fatal	Non-Fatal	
FORSCOM	149	36,592,000	4.072		15	324,804
TRADOC	9	2,245,000	4.009		1	16,986
HQDA	5	1,459,000	3.427		1	11,865
NGB	115	29,519,000	3.895	3	25	318,299
DARCOM	8	1,989,000	4.022		2	8,652
ASA	3	519,000	5.780			2,910
USACC	16	2,196,000	7.286	1	3	69,519
USAREUR	313	32,903,000	9.513	1	53	1,380,472
8th Army	51	8,581,000	5.943	4	17	243,812
WESTCOM	6	5,000	1200.000			6,560
HSC		124,000				
CONUS, Other		6,000				
Total	675	116,138,000	5.812	9	117	2,383,879

TABLE 3

All M880 Accidents: 1 Jan 80 - 31 Dec 80

MACOM	Accidents	Miles Driven	Rate Per Million Miles	Injuries		Total Cost($)
				Fatal	Non-Fatal	
FORSCOM	171	43,282,000	3.951	1	39	525,268
TRADOC	20	2,677,000	7.471		5	38,829
HQDA	6	918,000	6.536			9,675
NGB	121	51,723,000	2.339	1	41	470,825
DARCOM	6	3,556,000	1.687		1	10,488
ASA	1	592,000	1.689		1	13,215
USACC	25	3,520,000	7.102	1	7	68,586
HSC	1	176,000	5.682			5,200
USAREUR	303	47,806,000	6.338	3	30	857,317
8th Army	25	8,521,000	2.934	1	8	105,757
WESTCOM	5	4,000	1250.000			6,005
Total	684	162,504,000	4.209	7	132	2,111,165

TABLE 4

All M880 Accidents: Rate Per 1000 Vehicles

	1 Sep 77- 31 Aug 78	1 Jan 79- 31 Dec 79	1 Jan 80- 31 Dec 80
Accidents	740	675	684
Vehicles	19,170	20,690	27,920
Rate	38.60	32.62	24.50

TABLE 5

M880 Tire Failure Accidents: 1 Sep 77 - 31 Aug 78

MACOM	Accidents	Miles Driven	Rate Per Million Miles	Injuries		Total Cost($)
				Fatal	Non Fatal	
FORSCOM	6	25,686,000	.2337		7	36,971
NGB	3	25,578,000	.1173			3,518
USACC	4	1,588,000	2.5180		5	11,985
USAREUR	16	34,248,000	.4672	1	3	67,250
8th Army	3	5,634,000	.5325	1	7	80,580
Total	32	92,734,000	.3451	2	22	200,304

TABLE 6

M880 Tire Failure Accidents: 1 Jan 79 - 31 Dec 79

MACOM	Accidents	Miles Driven	Rate Per Million Miles	Injuries		Total Cost($)
				Fatal	Non-Fatal	
FORSCOM	3	36,592,000	.0819		4	15,252
NGB	3	29,519,000	.1016	1	1	35,540
USAREUR	15	32,903,000	.4559		2	57,052
8th Army	1	8,581,000	.1165		3	4,069
Total	22	107,595,000	.2045	1	10	111,913

TABLE 7

M880 Tire Failure Accidents: 1 Jan 80 - 31 Dec 80

MACOM	Accidents	Miles Driven	Rate Per Million Miles	Injuries		Total Cost($)
				Fatal	Non Fatal	
FORSCOM	3	43,282,000	.0693		2	11,095
NGB	8	51,723,000	.1546		5	24,131
USAREUR	13	47,806,000	.2719		4	178,046
8th Army	1	8,521,000	.1173		1	5,690
WESTCOM	1	4,000	250.0000			2,877
Total	26	151,332,000	.1718		12	221,839

TABLE 8

M880 Tire Failure Accidents: Rate Per 1000 Vehicles

	1 Sep 77- 31 Aug 78	1 Jan 79- 31 Dec 79	1 Jan 80- 31 Dec 80
Accidents	32	22	26
Vehicles	19,170	20,690	27,920
Rate	1.669	1.063	.931

TABLE 9

CAUSES OF M880 TIRE FAILURE ACCIDENTS

Time Period	Did Tire Failure Cause Accident?			What Caused Tire Failure?				Average Speed at Accident	MFG of Failed Tire
	Yes	No	NR*	Normal Wear/ Tear	Road Hazard	Design/ MFG	NR*		
1 Sep 77- 31 Aug 78	32	0	0	0	1	14	17	49 mph (19 rpts)	3 Goodyear 29 NR*
1 Jan 79- 31 Dec 79	22	0	0	0	0	9	13	46 mph (14 rpts)	4 Goodyear 18 NR*
1 Jan 80- 31 Dec 80	26	0	0	0	1	8	17	44 mph (20 rpts)	6 Goodyear 20 NR*
Total	80	0	0	0	2	31	47	46 mph (53 rpts)	13 Goodyear 67 NR*

*NR = Not Reported.